of Irkajpij. Hence it follows that the algal flora differs in its composition in a noteworthy degree in the eastern and western portions of the Siberian Polar Sea.

It has been stated that an abundance of large-sized luxuriant plants is a characteristic of the Arctic algæ. In this respect the vegetation of the Siberian Sea is considerably behind that in other parts of the North Polar Sea. The largest alga seen by Dr. Kjellman was a *Laminaria Agardhii*, whose length was 210 and greatest breadth 37 centimetres. Among the many specimens of *L. cuneifolia* examined there was none more than half so large as this. *L. solidungula* is about as large as middle-sized specimens of this plant from the coasts of Spitzbergen and Novaya Zemlya, about 90 centimetres long and 15 to 20 broad. The two species of Alaria, when they are largest, are about a metre in length. Other algæ almost without exception are stunted in comparison with plants of the same species from other portions of the North Polar Sea.

The collections of algæ made by Dr. Kjellman, according to the examination to which it has been possible to subject them, consist only of thirty-five species, of which there belong to the

Florideæ	12
Fucoideæ	16
Chlorophyllophyceæ	6
Phycochromophyceæ	1

These are not more than half as many as are known from the Murman and Spitzbergen Seas. With the exception of two, or possibly three, species, all also occur in other parts of the North Polar Sea.

The western part of the Siberian Polar Sea, at least to Cape Chelyuskin, must doubtless be considered to belong to the territory of the Spitzbergen marine flora, though poorer in individuals and species and more stunted than it. The algæ in the eastern part of the same sea also in a considerable degree correspond with those on the coasts of Spitzbergen and Novaya Zemlya, but in the composition of its Laminaria vegetation it has a trait foreign to the latter, and indicating a connection with the algæ in the north part of the Pacific.

ON THE COMPRESSIBILITY OF GLASS[1]

THE following experiments were undertaken with a view to determine by actual observation the effect produced on solids by hydraulic pressure. The instrument was constructed according to my directions by Mr. Milne, of Milton House, about two years ago, but it is only now that I have been able to devote myself to its application to the purposes for which it was designed. It consists of a hydraulic pump, which communicates with a steel receiver capable of holding instruments of considerable size, and also with a second receiver of peculiar form. This receiver consists essentially of a steel tube terminated at each end by thick glass tubes fitted tightly. It is tapped at the centre with two holes, the one to establish connection with the pump, and the other to admit a pressure-gauge or manometer. The steel tube may be of any length, being limited only by the extent of laboratory accommodation at disposal. The tube which I am using at present has a length of a little over six feet, and an internal diameter of about three-tenths of an inch. The solid to be experimented on must be in the form of rod or wire, and must, at the ends at least, be sufficiently small to be able to enter the terminal glass tubes, which have a bore of 0·08 inch, and an external diameter of 0·42 inch. The length of the solid is such that when it rests in the steel tube its ends are visible in the glass terminations.

When the joints have all been made tight the experiment is conducted as follows:—

A microscope with micrometer eyepiece is brought to bear on each end of the rod or wire. These microscopes stand on substantial platforms altogether independent of the hydraulic apparatus. The pressure is now raised to the desired height, as indicated by the manometer, and the ends of the rod are observed and their position with reference to the micrometer noted. The pressure is then carefully relieved and a displacement of both ends is seen to take place, and its amplitude noted. The sum of the displacements of the ends, regard being had to their signs, gives the absolute expansion in the direction of its length, of the glass rod, when the pressure at its surface is reduced by the observed amount, and consequently also by the compression when the process is reversed. As in the case of non-crystalline bodies, like glass, there is no reason why a given pressure should produce a greater effect in one direction more than in another, we may, without sensible error, put the cubical compression at three times the linear contraction for the same pressure.

As yet I have only experimented on glass, and only on one sort, namely, that made by Messrs. Ford and Co. of Edinburgh. It contains lead, and is very suitable for glass-blowing purposes. I have not yet analysed it. I have observed its compressibility up to a pressure of 240 atmospheres, and before proceeding to higher pressures I intend to determine the compressibilities of other solids, especially metals at pressures up to 240 atmospheres. The reason for taking this course is that having got two glass tubes to stand this pressure I am anxious to utilise them as far as possible before risking them at higher pressures.

The pressure in these experiments was measured by a manometer, which consists simply of a mercurial thermometer with a stout bulb, which is immersed in the water under pressure, whilst its stem projects outside.

The values of the readings of this instrument were determined by comparing it with a piezometer containing distilled water. This piezometer had been compared with others which had been subjected to the pressure of very considerable and measured columns of water on the sounding-line.

The mean apparent compressibility of water in glass was thus found[1] to be 0·00004868, or, multiplying by 1,000, to reduce the number of figures 0·04868 per atmosphere at temperatures from 1° to 4° C.

The manometer (No. 2) was compared with this piezometer. The temperature of the manometer was 12°·5 C., while the piezometer was enveloped in ice in the receiver. The ice was thus melting under the same pressure as the instrument was undergoing, consequently the piezometer was not exposed really to precisely the same temperature at each succeeding experiment.

For our present purpose the effect of the possible variation in volume due to this thermic cause is negligable, and we assume that the indications of our piezometer are comparable with those obtained in deep ocean waters. In a future communication I hope to return to this point.

In Table I. we have in the first column the number of observations meaned for each pressure from which the average values of the manometer-reading under A, and of the piezometer-indication under H are computed.

Manometer No. 2, when treated simply as a thermometer, showed at atmospheric pressure a rise of one division for a rise of 0·233° C. in temperature. Piezometer K, No. 4, was filled with distilled water, and contained 7·74 cubic centimetres at 0° and atmospheric pressure. It is made of Ford's glass, though not drawn at the same date as the experimental rod.

TABLE I.—*Comparison of Manometer No. 2 at 12·5° C. with Piezometer K, No. 4, in ice melting under pressure*

Piezometer K, No. 4, contains at 0° and atmospheric pressure 7·74 cub. cent. of water.	Number of observations meaned.	Pressure in divisions of manometer No. 2.	Apparent contraction of water per thousand. K, No. 4.
		A.	H.
Temperature of manometer 12·5° C.	4	26·08	4·0228
Piezometer immersed in ice... ...	4	30·28	4·6534
Melting under pressure A	1	36·20	5·5972
Probable temperature between – 1° and 0° C.	5	40·08	6·1045
	3	50·08	7·6043
	3	60·20	9·1057
	3	70·08	10·5163
Total number of observations ...	23		
Mean reading of manometer ...	... ...	43·61	
Mean apparent contraction of water in piezometer	... ...	... ...	6·6495

Dividing the mean apparent contraction of the water in the piezometer by the apparent compressibility of water in glass (0·04868), we have for the pressure corresponding to a rise of 43·61 divisions on manometer No. 2 at 12·5° C.

$$P = \frac{H}{0{\cdot}04868} = \frac{6{\cdot}6495}{0{\cdot}04868} = 136{\cdot}6 \text{ atmospheres.}$$

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[1] Substance of a paper read before the Royal Society of Edinburgh, June 21, by J. Y. Buchanan.

[1] *Proc.* Royal Society of London, 1876, p. 162.

But this pressure produces a rise of 43·61 divisions on manometer No. 2. We have then for the value of one division on the manometer—

$$a = \frac{136{\cdot}6}{43{\cdot}61} = 3{\cdot}132.$$

Hence to convert readings of manometer No. 2 into atmospheres we have to multiply by 3·132 the difference between the manometer reading under pressure and that at atmospheric pressure.

In another series of experiments piezometer K, No. 4, was compared with manometer No. 2, both being at a temperature of 12·5° C., and the following results were obtained as the mean of nineteen observations:—

Mean rise of manometer No. 2 ...	(A)	41·35 divisions.
Mean apparent contraction per thousand of water in piezometer K, No. 4	(H)	5·8782

But from the results in Table I. we have for the pressure in atmospheres—

$$P = 3{\cdot}132 \times A = 3{\cdot}132 \times 41{\cdot}35 = 129{\cdot}5 \text{ atmospheres.}$$

And the apparent compressibility of water in glass at this temperature (12·5° C.) in volumes per thousand per atmosphere is—

$$M = \frac{H}{P} = \frac{5{\cdot}8782}{129{\cdot}5} = 0{\cdot}04539.$$

We see then that at pressures up to 240 atmospheres the property peculiar to water of diminishing in compressibility with rise of temperature is preserved unimpaired, and the amount of change corresponds closely with that found at low pressures in the experiments of Regnault and Grassi.

In Table II. the results obtained are summarised. In the first column we have the number of the series, and in the second the number of observations which constitute the series. Under T we have the temperature of the receiver and therefore of the rod in it. The experiments were made at the temperature of the room, which varied very slightly. The arithmetical mean of the values of T is 12°·77 C. Under A we have the pressure in terms of the scale of the manometer; that is the difference between the readings of the manometer when the pressure was up and when it was equal to that of the atmosphere. Under P (3·132 × A) we have the pressure in atmospheres which is obtained by multiplying A by 3·132 (see Table I.) Under D we have the sum of the expansions observed at each end in terms of the micrometer, divisions which had identical values. Under F we have the values of D reduced to parts of an inch by multiplying them by 0·000417. Under Q we have the greatest deviations from the mean amongst the individual observations forming this particular series. R represents this deviation as a percentage of the total expansion (F). Under H we have the linear compression (in inches) of a rod one million inches long under a pressure of P atmospheres. K is the corresponding value for one atmosphere, and N = 3K is the cubical compression of the glass per million per atmosphere.

The total expansion on D was determined by observing the expansion at each end and adding them together. These partial expansions were not always, nor indeed often, of exactly the same extent; the excess was sometimes on the one side and sometimes on the other. The effect of the rise of pressure is to extend the containing tube and to compress the contained rod. On the relief of pressure the tube shortens again and the rod recovers its length, and there is necessarily a sliding of the one or the other, and it depends entirely on minute local circumstances whether the rod finds it easier to return to its original relative position or to another. In some experiments made previously to those quoted in Table II. the rod had greater freedom of motion longitudinally, and it happened several times that it crept bodily to the one end, necessitating the opening of the apparatus to replace it in a position suited to observation. Afterwards stops were placed in the tube, which, while setting limits to the crawling motion, did not in any way interfere with the expansion and contraction. The results of these previous experiments are not included in the table, because they were merely tentative with a view to learning the details of the kind of experimentation; and further, because in the microscope at the east end the power used was very low, and the micrometer insufficiently delicate.

The micrometers used were: at the east end a photographic copy of Hartnack's eyepiece micrometer, and at the west end one of Morz's. They were both compared, and the values of their divisions as used determined by comparison with a stage micrometer of Smith and Beck, obligingly lent me by my friend Dr. William Robertson, who had very carefully verified its graduations. It is remarkable as a coincidence that the values of the divisions turned out to be identical, namely, 0·000417″.

In the observations recorded I made no attempts to subdivide the micrometer divisions further than to estimate a half. As the micrometer readings are not affected directly by the pressure, the deviation per cent. should be, as it is, the less the higher the pressure; and there is no doubt that the higher the pressure is the greater is the accuracy of the observation. The only way in which the pressure affects the reading of the micrometer is that when it is sufficiently high it produces a microscopic distortion of the tube which throws the point very slightly out of focus. This is remedied by a slight touch of the fine-adjustment screw of the microscope.

TABLE II.—*Summary of Experiments on the Compression produced on a Glass Rod by Pressures up to 240 Atmospheres*

Series No.	Number of observations meaned.	Temperature. Cents.	Pressure.		Compression of rod.		Greatest deviation from mean.		Linear compression per million.	Linear compression per million per atmosphere.	Cubical compression per million per atmosphere.
			Manometer No. 2.	Atmospheres.	Micrometer divisions.	Inch.	Inch.	Per cent.			
		T.	A.	P. $(3{\cdot}132 \times A)$.	D.	F. $(0{\cdot}000417 \times D)$.	Q.	R. $\frac{100}{}$.	H. $\left(\frac{10^6}{75{\cdot}05} F.\right)$	K. $\left(\frac{H}{P}\right)$	N. (3 K).
1	8	13·5	20·40	64	11·13	0·0047	0·00047	10·0	62·6	0·98	3·0
6	11	12·2	34·81	109	18·05	0·0075	0·00044	5·8	100	0·92	2·8
2	8	13·7	37·51	118	19·81	0·0083	0·00034	4·1	110	0·94	2·9
7	10	12·3	50·30	157	27·00	0·0113	0·00042	3·7	150	0·96	2·9
3	13	12·8	50·49	158	26·84	0·0112	0·00056	5·0	149	0·95	2·9
4	8	12·5	56·88	177	32·00	0·0133	0·00042	3·2	178	1·00	3·0
8	7	12·5	62·21	195	33·71	0·0140	0·00033	2·3	187	0·96	2·9
5	10	12·5	62·97	197	35·39	0·0148	0·00046	3·1	197	1·00	3·0
9	10	12·8	68·94	216	37·10	0·0155	0·00058	3·7	206	0·96	2·9
10	6	12·9	76·53	240	40·08	0·0167	0·00059	3·5	223	0·93	2·8
										0·960	2·92

The micrometers used were eye-piece scale micrometers. The values of their divisions as used were identical. One division in the eye-piece corresponded to 0·000417 inch on the stage. Length of glass rod experimented on 75·05 inches. Diameter of ditto, 0·28 inches. Weight of rod 209·5 grammes. Date of experiments June 3, 4, and 7, 1880.

The general result of these experiments is that the linear compressibility of the glass experimented on is 0·96 and its cubical compressibility 2·92 per million.

Grassi[1] gives as the means of his observations at pressures up to ten atmospheres:

Glass ... 2·25 ... Crystal ... 2·804 and 2·8584

So that our results agree closely with those found by him for crystal.

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[1] *Ann. Chim. Phys.*, (1851) [3], 31, p. 477.

We have then the apparent compressibility of water in glass at 2·5° C.	0·04868	
Add compressibility of glass	0·00292	
True compressibility of water at 2·5° C. ...		0·05160
And the apparent compressibility of water at 12·5° C. is	0·04539	
Add compressibility of glass	0·00292	
True compressibility of water at 12·5° C. ...		0·04831

Grassi gives the following values for the true compressibility of water at various temperatures :—

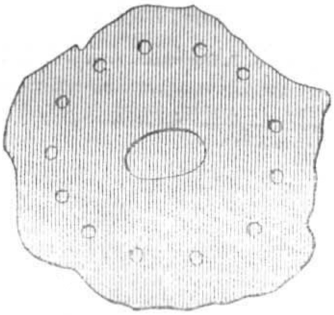
At 1·5° C.	0·0515	
At 4·1° C.	0·0499	
Mean		0·0507
At 10·8° C.	0·0480	
At 13·4° C.	0·0477	
Mean		0·0478

My results agree very closely with these.

Before concluding I would call attention to a very curious phenomenon which I have never seen noticed, namely, the peculiar *noise* which accompanies the relief of pressure in a mixture of ice and water.

In comparing the Piezometer K No. 4, in melting ice with the manometer at 12·5° C., I proceeded gradually from lower to higher pressures. When the pressure which was relieved was 100 or 120 atmospheres, I thought I noticed a slight noise. On raising the pressure higher the noise became more and more distinct, until when the pressure relieved was over 200 atmospheres, it was distinctly audible at a distance of 5 feet or 6 feet. It resembles the noise produced by bending a piece of tin backwards and forwards, and is markedly intensified by accelerating the relief, just as the noise made by blowing off steam is intensified by enlarging the outlet. When the relief valve is opened very carefully it whispers gently but very distinctly, till the pressure is all down. If opened comparatively briskly, but still with great care, the noise is comparatively loud but more rapidly used up. I forbear making any reflections until I have been able to study this phenomenon more closely.

Pieces of clear ice which had been subjected to high pressure in the receiver were finely laminated in parallel planes. In each plane there was a central patch surrounded near the sides of the block by a ring of spherules.



The annexed figure gives an idea of the arrangement in a plane of lamination; the size of the spherules is greatly exaggerated.

The lamination of ice by pressure in one direction is well known. I am not aware that its production by pressure in all directions has been noticed. I hope to pursue my observations on this subject.

J. Y. BUCHANAN

THE CONGRESS OF BOHEMIAN PHYSICIANS AND NATURALISTS

THE first Congress of Bohemian Naturalists and Physicians met at Prague on May 14 last. More than 400 members met under the presidency of M. Krejcí, M. Eiselt, M. Koristka, and M. Studnicka. The first general meeting was opened by M. Krejcí, Professor of Geology, who delivered an inaugural address "On the share of the Bohemian Nation in the Development of Natural Science." He showed that not only Bohemian workers in science were in the field up to the seventeenth century, but that when the Bohemian nation, after two centuries of political and national slavery, awoke to life again, it very soon took its part in the progress of natural science. The names of Purkyne, Rokytanský, Skoda, Bohdálek, Pitha, Blazina, Safarík, Celakovský, Fric, Krejcí, Helmhacker, and of many others, are known even beyond the boundaries of Bohemia. Many obstacles were placed in the way of these promoters of science; they were not assisted by Government, and even the ancient university of Prague was, and indeed is, almost exclusively German. But in spite of all difficulties scientific progress went on steadily, and at present the number of workers in science is very fair. Knowing the cosmopolitan character of science, the Bohemian nation values equally the progress made in England, France, Germany, Italy, and Russia; it wishes only that its own share—if proportionately small—may be recognised by others. The great languages of the world are like the sea, which carries the ships and steamers of all nations; but the languages and literature, of small nationalities—of the Danes, Swedes, Dutch, and Bohemians—resemble so many rivers irrigating and fertilising the continents by which the sea is surrounded.

On May 15 and 17 sectional meetings took place. On the 16th the members visited the village Chuchel, where Prof. Krejcí explained to them the very interesting distortions of the silurian strata on the left bank of the river Vltava (Moldau). In the evening of the same day the members assembled at a banquet, where especially the healths proposed by Prof. Safarík were heartily responded to. He spoke first of the progress of science in Bohemia and its relation to scientific investigation in England and France; he then proposed the health of the distinguished Russian naturalists, referring chiefly to Mendeleeff, Butleroff, Menshutkin, Chebysheff, Shecheneff, Mechnikoff, and Kowalewski; finally he drank to the Nestor of palæontological research, to Joaquin Barrande, who at Prague has carried out the chief part of his scientific work.

In the first section (medicine) papers were read on purely professional subjects.

The second section was devoted to mathematics. Besides several mathematical papers Prof. Augustin spoke on cyclones and anticyclones; M. Doubrava read a paper on electricity; M. Domalip explained the action of a magnet on a current of electricity traversing a rarified medium; Prof. Charles Zengef gave an account of his method of constructing achromatic lenses by means of a combination of crown-glass and certain liquids. Excellent microscopic photographs made by the aid of these lenses were shown. For astronomical purposes lenses with an opening of 2 inches and a focal distance of only 9 inches have been constructed according to this method with complete success.

In the third section (Natural Science) the following papers were read:—Prof. Borický, on the structure of the Bohemian porphyries. He showed that they frequently contain the mineral "cordierite," which hitherto had not been found in Bohemia. According to Prof. Borický a great part of the Bohemian porphyries must be classed as *siliceous porphyrites*. Prof. Fric demonstrated a new genus of the ganoids found at Kounová, near Rakovník. This fish resembles the genus Palæoniscus, but its scales are very different. He gave to the new genus the name of *Trissolepis kounoviensis*.

M. Bayer gave a report on the characters of the skulls of some batrachia. Comparing the skull of the genus Pelobates with that of other genera, he found that the skull of Pelobates differs essentially from all others, and that this genus does *not* form the connecting link between the Ranidæ and the Bufonidæ. M. Hellich read a report on the genital apparatus of the genus Cypris. He supplemented the data given by Zenker, and corroborated in a certain sense the new observations of Weissmann. A series of plates belonging to a new work on Bohemian cretaceous Echinodermata was shown by Dr. Ottomar Novák, and their peculiarities were explained. M. Ladislav Duda gave a preliminary account of the anatomy of the Bohemian hemiptera, especially of the section Scutata. He has discovered on the fore feet of these insects a comb-like apparatus, by means of which the insect cleans its tentacles. In Bohemia as yet 401 species of hemiptera have been found. Prof. Borický showed to the members many interesting novelties in mineralogy, as, *e.g.*, the Rösslerit, a mineral of which as yet only three specimens are known. Dr. Vejdovský exhibited the second part of his work on the comparative morphology of the annelids, containing a new system of the Oligochæta and their anatomical details, together with their affinities to the Turbellaria and vertebrata. Dr. Vejdovský proposes the following arrangement of the new families of the Oligochæta:—(1) Amedullata (Aeolosoma), (2) Chætogastrida, (3)